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Adjusting extension models to the way farmers learn

by

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Abstract

Extension services play a key role in helping developing countries modernize their agriculture and grow. Yet, these services have almost universally performed below expectation. The hypothesis proposed here is that extension systems could perform better if they delivered services structured on the way farmers learn. To inform this hypothesis, we review critically existing extension systems, extract from learning models and empirical studies regularities about how farmers learn, and propose a set of reforms to existing extension services that match learning channels.

The role of agricultural extension services for development

As was learned from the Solow growth accounting model, TFP growth is an important source of aggregate economic growth. This is particularly true for agriculture. For that sector in all developing countries in 2000-07, 2/3 of growth was explained by productivity growth and 1/3 by factor deepening (Fuglie, 2010; Gollin, 2010). Improving agricultural productivity is for that reason one of the key objectives for governments in most developing countries, not only from the perspective of growth, but also to achieve food security and improve the welfare of a large share of their populations that is engaged in agriculture.

Public investment in productivity enhancing public goods and technologies continues to be large (Feder, 1986), even if there is a chronic under-investment in agricultural research (Alston, 2000). However, adoption of technological innovations is constrained by many factors (Jack, 2011). Prominent among them are the following:

Profitability in a risk-return framework
Information about availability of innovations
Information about use, given heterogeneity of circumstances

Agricultural extension services have a fundamental role to play in making information available about the availability and fit of innovations to individual conditions of use.

Agricultural extension has been one of the largest public institutions in developing countries, employing and training more than a million extension workers at a world scale, who in turn reach a multiple of millions of farmers (Anderson and Feder, 2007). According to the Neuchatel Initiative (Swanson and Davis, 2014), there are some 618,000 extension agents in China, 90,000 in India, 54,000 in Indonesia, 46,000 in Ethiopia, 35,000 in Vietnam, and 24,000 in Brazil.

The general observation, however, is that current extension systems have not lived up to expectations. Available technological innovations are often only scantly

adopted. Large segments of the farm population do not know about the existence of these innovations, or do not know how to use them for maximum efficiency. There is consequently a large literature critical of current extension services. Dispersed attempts have been made to experiment with alternative designs. And are many efforts to explore how to improve the current extension system. The proposition behind this note is that the redesign of extension services must correspond to the way farmers learn in order to effectively induce adoption and productivity gains.

Traditional approaches to extension

Traditional approaches to extension include the Training and Visit and the Farmer Field School systems. Both have been widely used and also widely criticized.

Training and Visit (T&V)

The World Bank promoted the "Training and Visit" system in over 40 developing countries in the 1970s and 1980s. This system introduces a cadre of trained agriculture extension workers operating under a single line of command, replacing (in India) the previous system of multipurpose village level workers. At the lowest level of the T&V system are village extension workers who cover each about 800 farm families, 10% of which are chosen as "contact farmers" -- mostly larger, well-to-do farmers, who receive intensive training in communication from the agriculture extension workers and are expected to adopt the improved practices and disseminate them among other farmers (Feder, 1986).

What has been the impact of the T&V extension system? This question is yet to be answered with rigorous, modern impact evaluation techniques although there has been growing evidence accumulating over the years. Some of the early evaluations have been under the form of structural economic analyses of investment projects that estimate benefits to farmers and rates of return using an economic surplus approach (Anderson and Feder, 2007). Feder (1986) estimated no significant impact of T&V-type extension on rice production in India, while the return in wheat producing areas was estimated at 15% using simple differences between districts with and without the T&V system a few years after introduction of the extension system. While it is hard to attribute causality, as the author acknowledges citing lack of disaggregated panel data and identification options, these are the only early estimates available.

Gautam (2000) studied the impact of a revised extension system in Kenya based on T&V called NEP-I and NEP-II projects. He found that the extension system was mis-targeted away from smallholder farmers. The system was in addition not effective for beneficiaries. First, the content of services was not demand-driven: it was mainly focused on modern methods of maize production while many smallholder farmers require services on diversified cropping systems and less costly technology. Second, there was no notable change in quality and quantity of extension services from before the program. Third, adoption followed awareness that was limited to maize-related messaging and technology, which already had a high baseline level implying limited impact of the new program. Fourth, the system was misallocated to districts

that already had high baseline productivity, with again limited potential for impact. Finally, productivity increased substantially in districts with low baseline productivity but since most of the program was targeted towards high productivity districts, data do not reveal a significant overall impact of extension services.

Anderson and Feder (2007) concluded their review of evidence on T&V by claiming that the system introduced a top-down hierarchical structure with no adjustment to farmers' demands for services, no accountability to farmers, no effective feedback mechanisms, a strict schedule of visits (with no flexibility and no adjustment to heterogeneity of farmer circumstances), and that it was too costly and excessively dependent on external funding, failing as a consequence to achieve financial sustainability. While the system was largely abandoned in its original form, it is still at the basis of most of current existing services.

Farmer Field School (FFS)

Under the FFS approach, trained facilitators bring farmers to training schools to build skills using a discovery-based approach to learning, i.e., using experimental methods, typically with treatment and control plots managed by the student-farmers themselves under guidance of the trained facilitators. FFS is a participatory approach intended at developing a farmer's own understanding and decision-making capacity, rather than a top-down approach of transfer of information on what to do as in T&V. Student-farmers are trained to not only learn and decide, but also to communicate with others in the community. Results show that the approach can be effective in teaching farmers and helping them decide for themselves under their own circumstances, especially for such issues as the implementation of Integrated Pest Management practices and seed selection (Waddington and White, 2014). The problem with the approach is that it is not cost-effective, and as a consequence is not scalable and sustainable. Trained student-farmers have difficulty communicating to others what they have learned as it is too complex to be transmitted to un-trained farmers. Additionally, they are not equipped with demonstrations (such as treatment and control plots as used at the FFS) in attempting to provide the information to others.

Agricultural extension system and NFSM in India

Dedicated agricultural extension services in India, like most around the world, started with the top-down public T&V approach promoted by the World Bank during the Green Revolution period. Over time, this system has evolved to address some of the criticisms of limited reach and inadequacy of adaptation of content to local context. The current public extension system involves the Department of Agriculture at the national and state levels, with district and block level officers in charge of implementation. In recent years, under the current 12th five-year plan (2012-17), a decentralized agency known as the Agricultural Technology Management Agency (ATMA) has become the main coordinating body in charge of implementation. ATMA is a multi-stakeholder agency involving farmer interest groups, NGOs, the private sector, and public officials from different line departments within the agricultural sector. The link between research and extension is mainly

overseen by ICAR at the national level and by State Agricultural Universities (SAUs) at the state level. Krishi Vigyan Kendras (KVK), established at the district level, are experimental stations of SAUs where new technologies are tested on experimental plots and extension officers are trained before dissemination.

Recent years have seen a rise in private sector involvement in agricultural extension on a modest scale, including public-private partnerships (PPP), following liberalization and changes in agricultural policies in favor of increasing private sector roles. Some of the PPP initiatives are under the form of agri-clinics and agri-business centers covering part of the country. These initiatives focus on providing agricultural advisory services and sale of inputs through a cadre of trained agricultural graduates. Private sector players such as ITC, Tata, and Godrej among others have engaged in contract farming as part of vertical integration of their agro-based industries. They have provided extension services by establishing a network of agri-business centers and information kiosks (such as e-choupal by ITC and Tata Kisan Sansar by Tata Chemicals) that provide marketing and price information to farmers.

In addition, many NGOs provide the last mile connectivity between the extension system and farmers through self-help groups (SHGs) and farmer-based organizations (FBOs). BASIX, PRADAN, and BAIF are large national level NGOs engaged in farmer welfare and increasing agricultural productivity, concentrated in the southern Indian states.

Mass media have always been used both by public extension system and more recently by NGOs. Specialized programs on TV, Radio (Krishi channels), and newspapers are among important avenues through which farmers get information. More recently, the government has set up "Kisan call centers" to address demand-driven information requests. Non-profit technology firms like Digital Green provide video-based extension services that have been shown to have better impact than traditional systems.

Glendenning et al. (2010) and Ferroni and Zhou (2012) evaluate the Indian extension system, finding many inefficiencies and they call for greater synergies between private and public sectors. The public extension system continues to focus on wealthier progressive farmers and few other farmers report having accessed the extension service. Most small and marginal farmers get information and advice from input dealers and broadcast media; this is particularly salient for fertilizer and animal feed. The authors criticize weak links between extension and research, saying that only few farmers attend demonstrations at SAUs and KVKs. While PPP and private sectors models have hailed to address some of the gaps, credit constraints and licensing requirements have prevented them from reaching scale. The private sector provides more context specific services on both production and post harvest management; however, they tend to service larger contract farmers who are part of their vertical supply chains.

Under the 12th Five Year Plan, the Government of India introduced the National Food Security Mission (NFSM) in 2007 with a focus on increasing productivity of core cereal crops (NFSM-Rice and NFSM-Wheat) and pulses (NFSM-Pulses). The policy specifies that small, marginal, and women farmers should comprise at least 33 % of contact farmers in the extension system. On demonstrations, NFSM provides detailed guidelines on the intensity, stating demonstrations should be held on 0.4 ha of land for every 100 ha, by dividing contiguous plots into experimental plots for new techniques and the others for existing practices in order to show visually the impact to farmers. Extension officers are required to provide sufficient advance information before demonstrations and display boards on demonstration plots. Additional field days are required during the reproductive phase to ensure follow-up and address concerns during the entire farming cycle.

The International Rice Research Institute (IRRI) has held cluster demonstrations under NFSM-Rice for stress resistant rice varieties (STRV) on 9,700 ha of land across 51 districts. Apart from disseminating information on modern STRV rice among farmers, the demonstrations have yielded seeds to meet increasing demand from farmers. A critique of this cluster approach is that it demonstrates the new technology under the cultivation conditions advocated by the extensionist and not by the farmer. The farmer may not be able to replicate the treatment the year after when he has to buy inputs and pursues his own objective function. What is being demonstrated to other farmers similarly does not correspond to what a peer farmer would be doing. For this reason, this approach has been criticized as broadly ineffective in helping farmers learn and decide to adopt.

The Neuchatel Initiative on Agricultural Extension and Advisory Services (EAS)

The Global Forum for Rural Advisory Services (GFRAS, 2014) is a platform for member organizations (especially producer organizations) where information is exchanged about best approaches and methods for the provision of rural advisory services in different country situations. It is also referred to as the Neuchatel Initiative and is supported by a coalition of donors including the Gates Foundation, the European Commission, and USAID. Based on the comparative analysis of extension services, it has evolved a set of recommendations about the desirable features of extension and advisory services (EAS) that include the following:

- EAS should include farmer **training**, with capacity development at the individual and organizational levels
- EAS should be **participatory** of farmers, in particular through producer organizations (PO)
- It should link extension to **research** as part of an Agricultural Innovation System, with feedbacks between the two
- It should be **pluralistic**, with roles for the public, private, NGO, and PO sectors. This requires the partial privatization, decentralization, and coordination of advisory services

- It should be **demand-driven**, responding to farmers' demands for advice, in part through POs
- It should be **financially sustainable**, with co-financing of services
- It should **diversify advice** beyond technology adoption to such issues of concern to farmers as poverty, gender, empowerment, access to credit and insurance, marketing, risk management, environmental protection, and links to the agricultural innovation systems
- And it should recognize **diversity** and **heterogeneity** of conditions and needs across farmers.

These broad principles derived from comparative experiences are useful in identifying desirable features for the design of extension services.

How farmers learn: Alternative channels

We use here the review paper prepared by Sadoulet (2016)[1] for this workshop that presents a number of models through which farmers learn. We use them to identify the corresponding dimensions that extension services should have if they are to correspond to the way farmers learn. These dimensions are the following:

- **Private learning by Bayesian updating**. This consists in learning-by-doing based on individual actions. Prior knowledge about a stochastic phenomenon is updated based on information received in the latest period (Besley and Case; Bardhan and Udry; Wang).
- **Social learning (learning from others) with updating and aggregation** of observations collected from others according to a chosen pattern of weights. Learning from social networks is thus an important complement to direct learning from extension services (Chandrasekhan; Mobius; Ben Yishay and Mobarak).
- **Learning by comparing and differencing**. This is the central learning approach in impact analysis, where fixed effects (farmer and plot characteristics, weather events) are subtracted away by measuring impact as the difference between observed outcomes in treatment and control plots. At the individual level, with only one plot, this is done with zero degrees of freedom in a particular year. At the social level, this is done by differencing average outcomes from treatment and control plots.
- **Learning by acquiring knowledge from others**. Learning from others in deciding for oneself could be through the transmission of knowledge or by imitating the behavior of others. Empirical results show that the transmission of knowledge may be more prevalent in social networks than the transmission of information on actions. This may be because information on actions is not willingly transmitted for liability and reputation reasons, when transmission of knowledge has no implications for eventual adverse outcomes (Tjernstrom; Cai el al.; Udry and Goldstein).
- **Learning from others under heterogeneity of circumstances**. Heterogeneity of conditions (e.g., soil types) reduces learning from others

[1] See references in this section in the Sadoulet (2016) paper.

(Tjernstrom). There is less learning from others in rice (more heterogeneous conditions) than in wheat farming (more homogenous) (Munshi). More unobserved characteristics of others decreases learning from others, and induces more private learning. With heterogeneity, farmers learn more from peer farmers (people more similar to them), and perhaps require more complex contagion to decide on adoption (information from more than one peer farmer) (Beaman, Magruder, et al.).

- **Learning by trusting**. If trust is important in deciding to imitate or use transmitted knowledge, farmers will learn more from large/lead farmers with social reputation. Farmers will rely on individuals in social networks where trust prevails, such as SHG, caste, community members, and members of a voluntary organization (Ben Yishak and Mobarak).
- **Learning by communicating and deliberating.** Farmer field days serve for demonstrating, training, and confirming/interpreting information received. They can be very influential on adoption (Emerick et al., 2016).
- **Learning through noticing.** Farmers can fail to notice important features in the information available. By failing to notice some of the determinants of outcomes, omitted variable biases are created in learning. Helping notice can reduce biases in making use of available information (Schwartzstein; Hanna et al.).
- **Learning from incomplete and noisy evidence.** If evidence is incomplete about the value of an innovation, farmers will rely more on opinion leaders. Under these conditions, best users (serving as opinion leaders) give more precise signals about an underlying causal relation that farmers can obtain for themselves. Self-selection through bidding or WTP may help reveal who are the most informative users (Chassang; Dupas; Miller and Mobarak).
- **Learning strategically**. Experimenting by early adopters (people with lower discount rates) creates positive externalities on others. Farmers with higher discount rates may delay adoption to learn more from others (Besley).

Adapt new approaches to extension to the way farmers learn

Each of these learning mechanisms has implications for the design of extension services if these services are to be adapted to the way farmers learn for adopting. Specifically:

- **Private learning by Bayesian updating.** A longer time series of data on one's own plot increases expected profits from adoption as it makes input decisions more precise. Keeping formal records (IT based) on past practices (actions), weather (events), and outcomes would help farmers make the updating process more precise.
- **Social learning (learning from others) with updating and aggregation.** Panel data with a larger cross-sectional base of identical others allows more precise updating in social learning. Exchange of information across farmers with information on actions and weather events enhances social learning. Incentives can be given to peer farmers to induce adoption by themselves and for them to communicate lessons learned to others. Information on

others (household and plot characteristics) would help reveal who are your own peers. Demonstrations can be organized for clusters of peer farmers. Keeping formal records (IT based) on others will help updating in social learning.

- **Learning by comparing and differencing.** As opposed to cluster head-to-head demonstrations, head-to-head plots are managed by farmers on their own plots. Farmer field days and visits for training are organized using the H-to-H plots.
- **Learning by acquiring knowledge from others.** If social networks do not convey on decisions, provide separately information on decisions by others. Use public postings when subsidies have been used.
- **Learning from others under heterogeneity of circumstances.** Use peer farmers as injection points and communicators. Let demo farmers chose C to reveal type to others. Reveal dimensions of heterogeneity to help others identify their own peer farmers. Demonstrate with clusters of similar farmers.
- **Learning by trusting. Find out who are the most trusted farmers in the community.** This may be larger/lead farmers. Use voluntary organizations for self-selection into trusted groups, such as women SHG, producer organizations, castes. Mutual insurance networks reveal relations of trust.
- **Learning by communicating and deliberating.** Organize farmer field days, with multiple visits to allow heterogeneity and peer farmer recognition. Organizations where psychological security exists (e.g., SHG) facilitate communication. Dealer demonstrations can achieve financial sustainability and scalability, but may need local monopoly to create incentives to invest in the generation of public knowledge.
- **Learning through noticing.** Provide information on relationships in the data to reduce omitted variable effects. Make available summaries of relevant relationships in the data.
- **Learning from incomplete and noisy evidence.** Use lea farmers as entry points when information is very incomplete. Induce self-selection of best users through auctions and WTP. This will create a trade-off between relevance (peer farmer) and completeness (lead farmer) of information.
- **Learning strategically.** In poor populations with high discount rates, give subsidies to induce the emergence of early adopters. Cooperation in experimentation can help internalize learning externalities. This gives a role to producer organizations in managing adoption for collective learning (CREA groups in France and Argentina).

Suggestions for the design of new approaches to extension in a changing context

The critical review of existing approaches, together with lessons from theory as to how farmers learn, and empirical results from recent experiments suggest ideas for the design of new approaches to extension. These will be discussed in the FERDI workshop. Some key results are the following:

- Critical reviews of the T&V system suggest that contact (lead) farmers are not always the most effective disseminators of new technologies. Peer farmers may be more convincing, because they use the technology in a more relevant fashion for learning. When there is heterogeneity, selection of peer farmers from whom to learn may become essential.
- Reviews of the Farmer Field School approach tell us that student-farmers benefit from the training received, but are not in a position to in turn transmit their knowledge to other farmers in helping them decide. When decisions are complex, deciding by imitating may dominate over deciding by acquiring knowledge. Selection (incl. self-selection) of best farmers as demonstrators may then be the most effective source of information for social learning.
- Head-to-head cluster demonstration plots as practiced by ATMA and NFSM may not be effective because they do not demonstrate the technology according to farmers' objective functions and under farmers' own circumstances. Delegating to farmers the management of these H-to-H trials may be a better option.
- Choice of C by farmers is important to reveal type/conditions, especially under heterogeneity. This helps other farmers in the community identify who among demonstrators approximates most the status of peer farmer.
- Farmer field days are useful for training and deliberating. If trust is important in deciding, managing demonstrations through farmer organizations (such as SHG) is important, as recommended by the Neuchatel Initiative.
- Because updating is an essential approach to learning, providing information given to others on farmer type, conditions of plot, actions taken, and weather events is important. This allows both better private and social learning from the information available. Multiple visits to demonstration plots allow better updating by helping give more weight to peer farmers.
- Finally, the Neuchatel recommendation of seeking financial sustainability calls on making use of the private sector for the provision of information at the same time as it captures market share for the sale of inputs. Competition among dealers may create disincentives to experiment with public goods information.
- If strategic learning under conditions of high discount rates postpones adoption and individual experimentation, use of producer organizations to organize experimentation helps internalize externalities and reduce under-investment in learning.

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